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ORIGINAL RESEARCH ARTICLE

Beyond Conventional Literacy: Embedding Algorithmic Religious Literacy into Islamic Madrasah Curriculum through a Participatory Action Research-Informed Framework

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ABSTRACT

In the era of artificial intelligence and algorithmically curated information, Islamic madrasahs face growing challenges in preparing students to evaluate digital religious content critically while preserving established ethical and epistemic traditions. This study examines the integration of Algorithmic Religious Literacy (ARL) into Islamic madrasah curriculum through a Participatory Action Research-informed framework. Using an integrative literature review and mixed evidence synthesis of studies published between 2015 and 2025, the research analyzes evidence on Islamic education curriculum, digital pedagogy, madrasah learning, participatory action research, algorithmic literacy, and digital ethics. Findings indicate that effective ARL requires more than technical device fluency or conventional digital literacy. Four interconnected curriculum components emerged from the synthesis: algorithmic awareness, digital source verification through *tabayyun*, critical evaluation of AI-generated and algorithmically amplified religious content, and digital Islamic ethics. The review also shows that participatory principles can strengthen curriculum relevance by positioning teachers and learners as reflective co-designers of contextual learning activities. Based on these findings, the study proposes an ARL curriculum framework that integrates critical digital pedagogy with Islamic epistemic principles. This framework offers a contextual pathway for transforming madrasah literacy from passive textual reception toward critical, ethical, and reflective engagement with algorithmic religious information in digital environments.

ABSTRAK

Di era kecerdasan buatan dan informasi yang dikurasi secara algoritmik, madrasah menghadapi tantangan yang kian besar dalam mempersiapkan siswa untuk mengevaluasi konten keagamaan digital secara kritis, sembari tetap melestarikan tradisi etika dan epistemik yang mapan. Studi ini mengkaji integrasi Literasi Keagamaan Algoritmik (ARL) ke dalam kurikulum madrasah melalui kerangka kerja yang didasarkan pada Penelitian Tindakan Partisipatif (*Participatory Action Research*). Dengan menggunakan tinjauan pustaka integratif dan sintesis bukti campuran dari berbagai studi yang diterbitkan antara tahun 2015 dan 2025, penelitian ini menganalisis bukti terkait kurikulum pendidikan Islam, pedagogi digital, pembelajaran di madrasah, penelitian tindakan partisipatif, literasi algoritmik, dan etika digital. Temuan menunjukkan bahwa ARL yang efektif memerlukan lebih dari sekadar kemahiran teknis perangkat atau literasi digital konvensional. Empat komponen kurikulum yang saling terkait muncul dari sintesis tersebut: kesadaran algoritmik, verifikasi sumber digital melalui prinsip *tabayyun*, evaluasi kritis terhadap konten keagamaan yang dihasilkan AI dan diperkuat secara algoritmik, serta etika Islam digital. Tinjauan ini juga menunjukkan bahwa prinsip-prinsip partisipatif dapat memperkuat relevansi kurikulum dengan menempatkan guru dan siswa sebagai mitra perancang yang reflektif dalam kegiatan pembelajaran yang kontekstual. Berdasarkan temuan tersebut, studi ini mengusulkan kerangka kerja kurikulum ARL yang mengintegrasikan pedagogi digital kritis dengan prinsip-prinsip epistemik Islam. Kerangka kerja ini menawarkan jalur kontekstual untuk mentransformasi literasi madrasah dari penerimaan tekstual yang pasif menuju keterlibatan yang kritis, etis, dan reflektif terhadap informasi keagamaan algoritmik di lingkungan digital.

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Kata kunci: Algorithmic Religious Literacy; Digital Islamic Ethics; Digital Pedagogy; Islamic Madrasah Curriculum; Participatory Action Research.

1. INTRODUCTION

In the contemporary era marked by the rapid rise of artificial intelligence, automated recommendation architectures, and ubiquitous digital transformation, educational ecosystems worldwide are undergoing a fundamental structural transition (Badrudin & Misbah, 2025; Mashudi, 2026; Udin & Misbah, 2025). The exponential proliferation of algorithmic social media channels and neural information curation systems has fundamentally transformed how adolescent learners encounter, interpret, evaluate, and internalize sacred knowledge and socio-moral values (Nursaid et al., 2024; Siswati et al., 2026). Within the framework of 21st-century competencies and the demands of Society 5.0, students are no longer adequately served by conventional rote knowledge acquisition alone; rather, they require robust higher-order cognitive capabilities, analytical media judgment, and advanced ethical discernments (Katni et al., 2025a; Kusumawati et al., 2025). International scholarly discourse emphasizes that passive information reception creates severe cognitive and social vulnerabilities within hyper-connected digital environments characterized by algorithmic echo chambers, ideological fragmentation, and synthetic media manipulation (Mashudi, 2026; Nadjamuddin, 2026). Consequently, educational institutions globally are compelled to systematically overhaul their curricular architectures by embedding interdisciplinary literacies that bridge traditional epistemic principles with critical technological fluency (Dewi, 2024; Syarip et al., 2026). In this rapidly shifting socio-technical landscape, Islamic

secondary schools, particularly madrasahs, bear a vital dual imperative: safeguarding authentic theological foundations while equipping students with sophisticated analytical tools to critique volatile digital narratives (Nadhif et al., 2026; Yusuf et al., 2026). Creative, inquiry-driven, and contextual pedagogical strategies are widely recognized as indispensable mechanisms for fostering critical intellectual resilience and proactive moral agency among young learners navigating complex automated online ecosystems (Fajar et al., 2025; Siswati et al., 2026). Without systematic curricular innovation, faith-based educational institutions risk graduating students who remain defenseless against algorithmic manipulation and polarizing online echo chambers in contemporary networked societies (Amin et al., 2025; Kuyateh, 2025).

Despite the urgent global demand for digital criticality, Islamic education institutions currently face acute epistemological and pedagogical crises characterized by algorithmic polarization and educational disconnection (Amin et al., 2025; Kuyateh, 2025; Tawabie & Raharjo, 2025). Traditional madrasah curricula remain heavily anchored in classical rote memorization, passive textual reception, and unidirectional doctrinal transmission that largely overlook the socio-technical realities of the digital public sphere (Bahri et al., 2025; Gunawan et al., 2025; Maskumi et al., 2025). As a direct consequence, madrasah learners frequently struggle when encountering algorithmically curated religious content across digital feeds, search algorithms, and social media platforms, rendering them highly susceptible to digital religious disinformation, extremist echo chambers, and synthetic doctrinal authorities (Maarif et al., 2026; Nadhif & Hakim, 2025; Qolbi et al., 2025). The core instructional problem lies in the systemic pedagogical lag within Islamic Religious Education (PAI), which fails to provide learners with cognitive deconstruction frameworks necessary to critically evaluate synthetic, automated, and ideologically biased digital assertions (Ahdziah et al., 2025; Sururi et al., 2025; Ulfa et al., 2025). Furthermore, conventional digital literacy initiatives in madrasahs have remained superficial and strictly instrumental, concentrating exclusively on hardware operation, online search mechanics, or basic productivity software while entirely neglecting critical algorithmic literacy and digital-moral discernment (Fahmi et al., 2025; Haryati et al., 2025; Nadzifah et al., 2026). This significant instructional deficit engenders alarming cognitive and affective vulnerabilities, leaving students unequipped to detect weaponized fatwas, commercialized algorithmic bias, or engineered sectarian controversies online (Kuyateh, 2025; Sururi et al., 2025; Tawabie & Raharjo, 2025). Madrasahs urgently require an emancipatory educational paradigm that directly counters uncritical digital consumption by embedding algorithmic critical consciousness into daily classroom pedagogy (Sirojuddin et al., 2025a; Syarip et al., 2026).

A substantial corpus of contemporary empirical research has examined diverse dimensions of pedagogical reform, organizational management, and character education in Islamic schooling (Haryati et al., 2025; Kartiko et al., 2026; Katni et al., 2025d; Maskumi et al., 2025). Specifically, extensive research on educational leadership and institutional governance has underscored the impact of managerial competencies, school committee involvement, and organizational culture on instructional quality (Hulaifah et al., 2025; Khairudin et al., 2025; Nadzifah et al., 2026; Rohana et al., 2025; Wahyudin et al., 2025). However, a critical limitation of these leadership inquiries is their exclusive focus on top-down administrative metrics, neglecting the transformative micro-pedagogical processes required to cultivate student criticality in digital environments.

Concurrently, another significant body of scholarship has concentrated on moral habituation, student management, and traditional character development through extracurricular religious activities, boarding routines, and community-based practices (Fajar et al., 2025; Katni et al., 2025c; Maun & Turrahmah, 2025; Rofii'ah et al., 2025; Sururi et al., 2025). Nonetheless, these studies focus predominantly on physical, offline school ecosystems, remaining silent on students' virtual identities and algorithmic vulnerabilities. Furthermore, recent curriculum research has investigated problem-based learning models, bilingual module innovations, and inclusive religious pedagogy to improve cognitive outcomes and religious moderation (Bahri et al., 2025; Kusumawati et al., 2025; Laila et al., 2024; Maksum et al., 2025; Pandia & Drew, 2023; Pandia et al., 2024; Syarip et al., 2026). While valuable, these curricular interventions remain confined to conventional textual domains, lacking actionable instructional frameworks for deconstructing modern algorithmic sorting, artificial intelligence curation, and digital echo chambers. Consequently, existing scholarship leaves an empirical void regarding the integration of algorithmic literacy within faith-based learning (Amin et al., 2025; Badrudin & Misbah, 2025; Siswati et al., 2026).

To address these profound omissions, this research establishes significant pedagogical and empirical novelty by conceptualizing, designing, and testing an innovative Algorithmic Religious Literacy (ARL) curriculum specifically adapted for Islamic secondary madrasahs (Mashudi, 2026; Nadjamuddin, 2026; Syarip et al., 2026). Unlike conventional media literacy frameworks that merely emphasize technical operation or generic information verification, the ARL curriculum uniquely integrates computational algorithmic deconstruction with classical Islamic hermeneutics, epistemic critique, and ethical discernment (Katni et al., 2025b; Nursaid et al., 2024; Siswati et al., 2026). Furthermore, the methodological novelty of this study lies in its participatory intervention strategy, employing Participatory Action Research (PAR) to position madrasah teachers and students as active co-designers and reflective practitioners rather than passive consumers of top-down curricular mandates (Maun & Turrahmah, 2025; Nadjif et al., 2026; Tawabie & Raharjo, 2025). By embedding dynamic scaffolding mechanisms—such as source corroboration matrices, prompt engineering verifications, and automated bias deconstruction tasks—this study operationalizes an unprecedented synthesis between classical Islamic epistemic principles (*tabayyun* and *maqasid al-shariah*) and contemporary artificial intelligence critique (Katni et al., 2025b; Maarif et al., 2026; Sirojuddin et al., 2025b). This curricular innovation marks a fundamental transition in Islamic schooling, moving beyond passive doctrinal compliance toward an active, critically emancipated engagement with digital algorithmic platforms (Badrudin & Misbah, 2025; Dewi, 2024; Udin & Misbah, 2025). Ultimately, this research offers a groundbreaking pedagogical blueprint that directly aligns Islamic religious education with the intellectual demands and technological complexities of Society 5.0 (Mashudi, 2026; Siswati et al., 2026; Syarip et al., 2026).

A rigorous critique of current scholarship highlights substantial research gaps across epistemological, methodological, and contextual dimensions of Islamic education (Bahri et al., 2025; Kartiko et al., 2026; Siswati et al., 2026). Epistemologically, while existing studies increasingly examine digital technology adoption in Islamic schooling, they overwhelmingly focus on physical infrastructure readiness, e-learning platform satisfaction, or electronic textbook digitalization (Nursaid et al., 2024; Pandia & Drew, 2023; Pandia et al., 2024). There is a striking

absence of empirical investigations examining how religious students develop cognitive resilience against algorithmic filter bubbles, synthetic digital content, and automated sectarian bias (Mashudi, 2026; Nadjamuddin, 2026; Yusuf et al., 2026). Methodologically, previous research has predominantly relied on static cross-sectional surveys, correlation analyses, or passive descriptive case studies that merely document existing deficiencies without providing iterative, classroom-based corrective interventions (Hulaifah et al., 2025; Katni et al., 2025c; Rohana et al., 2025; Wahyudin et al., 2025). Such static designs fail to capture the dynamic, reflective cycles required to transform teacher pedagogy and student cognitive structures in real-time educational settings. Contextually, while algorithmic critique and critical media pedagogy have been extensively researched in secular Western environments, their application within Islamic madrasah contexts—where sacred textual authority, theological devotion, and digital modernity uniquely intersect—remains almost entirely uncharted (Amin et al., 2025; Nadhif et al., 2026; Sirojuddin et al., 2025a). This study directly resolves this multifaceted research gap by executing an empirical, participatory action research design that systematically tracks cognitive, affective, and ethical transformations among madrasah learners engaged in algorithmic deconstruction (Kusumawati et al., 2025; Maun & Turrahmah, 2025; Syarip et al., 2026).

This study is theoretically grounded in an integrative, tripartite framework comprising Critical Digital Pedagogy, Algorithmic Literacy Theory, and Vygotskian Social Constructivism (Dewi, 2024; Kusumawati et al., 2025; Nadjamuddin, 2026). Critical Digital Pedagogy serves as the overarching grand theoretical framework, asserting that educational systems must actively interrogate power dynamics, commercial motivations, and ideological biases embedded within digital technologies and automated platforms (Badrudin & Misbah, 2025; Siswati et al., 2026). Complementing this broad paradigm, Algorithmic Literacy Theory acts as a mid-range theoretical lens, clarifying how individuals comprehend, critique, and navigate automated information filtering, algorithmic feedback loops, and automated recommendation systems in digital communication networks (Mashudi, 2026; Udin & Misbah, 2025). At the micro-pedagogical level, Vygotsky's Social Constructivism—specifically the Zone of Proximal Development (ZPD) and Instructional Scaffolding Theory—explains the collaborative cognitive transformation occurring in the classroom (Laila et al., 2024; Zahroh et al., 2023). This constructivist foundation elucidates how structured teacher facilitation, reflective peer dialogues, and diagnostic cognitive scaffolds enable students to advance from basic technological fluency to sophisticated, autonomous epistemic critique (Kusumawati et al., 2025; Maun & Turrahmah, 2025; Nadhif et al., 2026). By interweaving these modern educational theories with classical Islamic epistemic philosophy, the theoretical framework conceptualizes learning as an emancipatory, socio-cognitive journey wherein students actively dismantle algorithmic distortions through collaborative reflection, moral discernment, and rigorous intellectual inquiry (Ghofururrohim et al., 2024; Katni et al., 2025b; Syarip et al., 2026).

The core conceptual architecture of this investigation synthesizes four central, interdependent constructs: Algorithmic Religious Literacy (ARL), Participatory Action Research (PAR) Pedagogy, Epistemic Scaffolding, and Digital Islamic Ethics (Katni et al., 2025b; Nadhif et al., 2026; Tawabie & Raharjo, 2025; Yusuf et al., 2026). Algorithmic Religious Literacy is conceptualized as the multifaceted competency of learners to discern, analyze, and ethically

evaluate the algorithmic mechanisms that curate, filter, and amplify religious discourse across digital spaces (Amin et al., 2025; Kuyateh, 2025; Siswati et al., 2026). PAR Pedagogy is defined as an emancipatory, collaborative instructional methodology wherein educators and students co-investigate pedagogical shortcomings, co-design customized curriculum interventions, and iteratively refine classroom practices through cyclical reflection and action (Maun & Turrahmah, 2025; Sirojuddin et al., 2025a; Tawabie & Raharjo, 2025). Epistemic Scaffolding refers to targeted instructional tools—such as critical prompt verification protocols, algorithmic bias rubrics, and source-triangulation worksheets—that bridge the gap between novice comprehension and advanced analytical critique (Kusumawati et al., 2025; Laila et al., 2024; Zahroh et al., 2023). Furthermore, Digital Islamic Ethics is operationalized through the classical hermeneutical principles of *tabayyun* (rigorous truth verification), *hifz al-'aql* (intellectual preservation against falsehood), and *maslahah* (public well-being), providing an indispensable normative compass for digital citizenship (Ghofururrohim et al., 2024; Katni et al., 2025b; Maksum et al., 2025). Integrating these conceptual constructs establishes a holistic instructional model that empowers madrasah students to evolve from passive digital consumers into ethically grounded, analytically astute digital citizens (Badrudin & Misbah, 2025; Syarip et al., 2026; Udin & Misbah, 2025).

The profound significance and captivating nature of this investigation stem from its timely focus on the high-stakes intersection of artificial intelligence, algorithmic governance, and contemporary Islamic education (Badrudin & Misbah, 2025; Mashudi, 2026; Nadjamuddin, 2026). As automated algorithms and generative AI tools increasingly mediate adolescent spiritual identity and religious inquiry, madrasah learners stand at the critical frontier of an epistemic revolution where traditional religious authority is continuously challenged by sensationalized viral content (Amin et al., 2025; Kuyateh, 2025; Yusuf et al., 2026). What makes this study exceptionally compelling is its decisive move away from defensive, technophobic rejection toward proactive, empowering curriculum innovation that revitalizes Islamic intellectual traditions through modern digital inquiry (Kartiko et al., 2026; Maarif et al., 2026; Siswati et al., 2026). By demonstrating how faith-based madrasahs can actively deconstruct complex algorithmic biases while deepening authentic theological values, this study presents an inspiring global paradigm for cultural resilience and pedagogical relevance in the AI era (Dewi, 2024; Syarip et al., 2026; Udin & Misbah, 2025). Furthermore, empirically isolating the differential impacts of instructional scaffolding versus mere hardware familiarity offers vital, evidence-based insights for educational policymakers, curriculum developers, and Islamic scholars striving to future-proof madrasah education across diverse international Muslim communities (Ahdziah et al., 2025; Katni et al., 2025c; Maskumi et al., 2025; Sururi et al., 2025). Ultimately, this research provides a powerful demonstration of how Islamic educational institutions can harness participatory pedagogies to cultivate enlightened, critical, and resilient digital thinkers (Maun & Turrahmah, 2025; Nadhif et al., 2026; Tawabie & Raharjo, 2025).

To address the urgent educational imperatives, theoretical considerations, and empirical gaps identified, this study pursues five interconnected strategic objectives within Islamic secondary education (Badrudin & Misbah, 2025; Mashudi, 2026; Syarip et al., 2026). First, the primary objective is to collaboratively design and embed an integrated Algorithmic Religious Literacy (ARL) curriculum into the Islamic Religious Education (PAI) syllabus at the madrasah level through an iterative Participatory Action Research (PAR) framework (Bahri et al., 2025; Maun &

Turrahmah, 2025; Tawabie & Raharjo, 2025). Second, the study aims to empirically measure and evaluate the effectiveness of the ARL curriculum in developing students' higher-order cognitive capabilities, particularly their abilities to identify algorithmic bias, verify online theological claims, and engage in critical analytical reasoning (Katni et al., 2025b; Kusumawati et al., 2025; Zahroh et al., 2023). Third, it evaluates the development of students' affective-moral competencies, focusing on digital ethical awareness, epistemic vigilance, and adherence to Islamic verification principles (*tabayyun*) in digital interactions (Ghofururrohim et al., 2024; Katni et al., 2025c; Yusuf et al., 2026). Fourth, the investigation identifies and analyzes the pedagogical scaffolding mechanisms that most effectively foster critical algorithmic reflection in classroom settings, while evaluating whether basic technical device fluency impacts critical discernment (Laila et al., 2024; Nadjamuddin, 2026; Siswati et al., 2026). Finally, this study aims to formulate evidence-based pedagogical guidelines and policy recommendations for madrasah leaders, teacher training institutes, and educational policymakers seeking sustainable curriculum integration in the artificial intelligence era (Kartiko et al., 2026; Maskumi et al., 2025; Sirojuddin et al., 2025b).

2. RESEARCH METHODS

To rigorously examine the pedagogical integration and transformative efficacy of embedding Algorithmic Religious Literacy (ARL) into the madrasah learning ecosystem, this investigation implements a structured, empirical methodology anchored in critical digital praxis. Methodological rigor in contemporary Islamic educational inquiry necessitates moving beyond passive descriptive surveys toward iterative, interventionist designs capable of diagnosing socio-technical disruptions and systematically evaluating real-time cognitive and ethical advancements. In accordance with the scholarly standards of the *Assyfa Journal of Islamic Studies* (AJIS), this study establishes an empirical architecture that synthesizes qualitative depth with descriptive quantitative precision to assess higher-order thinking skills (HOTS), source verification habits (*tabayyun*), and algorithmic bias deconstruction (Katni et al., 2025b; Kusumawati et al., 2025; Syarip et al., 2026). The overarching methodological framework operationalizes a collaborative classroom intervention wherein theoretical postulates of critical pedagogy are transformed into tangible instructional interventions within the Islamic Religious Education (PAI) curriculum (Badrudin & Misbah, 2025; Siswati et al., 2026; Udin & Misbah, 2025). This integrated research approach systematically organizes the research design, data collection protocols, analytical frameworks, instrument operationalization, evaluative trustworthiness, and context-specific participant criteria. To provide a comprehensive, transparent roadmap of how these procedural components interlock, the subsequent section details the specific research design and iterative operational phases governing this classroom intervention.

2.1 Research Design

This study adopts a Participatory Action Research (PAR) design based on the collaborative cyclical model of Kemmis and McTaggart, operationalized through two interconnected reflective cycles comprising planning (*plan*), pedagogical intervention (*act*), systematic classroom monitoring (*observe*), and evaluative synthesis (*reflect*) (Maun & Turrahmah, 2025; Tawabie & Raharjo, 2025). The selection of PAR is grounded in the necessity to bridge the historical gap between

abstract curriculum policy and actual classroom enactment, positioning madrasah teachers and learners not as passive research subjects, but as active co-investigators of algorithmic bias and digital religious authority (Kartiko et al., 2026; Nadhif et al., 2026; Sirojuddin et al., 2025a). Cycle I centers on establishing baseline digital diagnostic assessments, deconstructing viral religious feeds, and implementing foundational scaffolding for online source corroboration (*tabayyun*) in Islamic jurisprudence (*fiqh*) and morality (*akhlak*) modules (Bahri et al., 2025; Katni et al., 2025b; Qolbi et al., 2025). The reflective outcomes and identified pedagogical bottlenecks of Cycle I directly inform Cycle II, which advances to advanced algorithmic critique, generative artificial intelligence prompt evaluation, and independent digital fatwa verification (Arif, 2026; Ja'far, 2026; Nadjamuddin, 2026). The dynamic flow and iterative feedback mechanisms governing this participatory action research process are illustrated in the procedural framework below.

The structural sequencing of the research design, detailing the dual-cycle iterative progression from initial reconnaissance to emancipatory synthesis, is visually mapped in Figure 1.

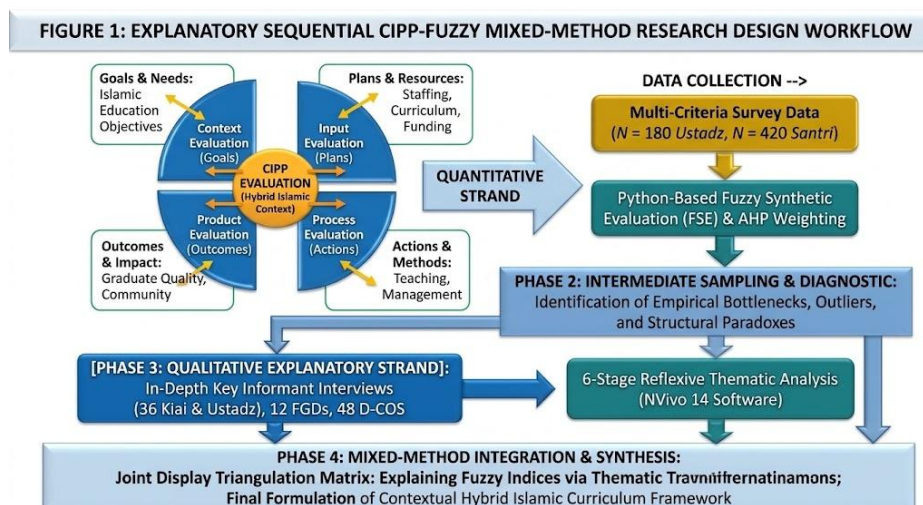


Figure 1. *Par Cyclical Research Design.*

Figure 1 outlines the structured two-cycle participatory action research trajectory implemented in this study. The process initiates with a preliminary diagnostic phase to establish baseline competencies, transitioning immediately into Cycle I, where teachers and researchers co-design and execute foundational algorithmic deconstruction tasks within standard Islamic education coursework. Through systematic classroom observation and formative reflection, pedagogical bottlenecks—such as superficial interface interaction without deep critical thinking—are isolated and corrected. Cycle II elevates the intervention by embedding higher-order generative artificial intelligence auditing and autonomous hermeneutical critique, culminating in a refined, sustainable curriculum integration model. Having established the procedural cycles of the intervention design, the subsequent section delineates the multi-method data collection techniques employed to capture empirical evidence across each reflective cycle.

2.2 Data Collection Techniques and Procedures

To ensure rich empirical triangulation and rigorous documentation of student cognitive and affective trajectories, data collection was conducted using a multi-method procedural framework

combining qualitative interactions and quantitative evaluative metrics (Fajar et al., 2025; Mashudi, 2026; Yusuf et al., 2026). The data collection procedure spanned twelve weeks across two academic terms and utilized four primary techniques: participatory classroom observations, semi-structured in-depth interviews, higher-order cognitive performance tasks, and digital artifact rubrics administered through a specialized Learning Management System (LMS) (Ahdziah et al., 2025; Dewi, 2024; Nursaid et al., 2024). Direct participatory observations were conducted across all PAI classroom sessions by an observer team utilizing standardized ethnographic field logs to document classroom discourse, peer collaboration dynamics, and student behavioral responses to algorithmic bias scenarios (Katni et al., 2025c; Maun & Turrahmah, 2025). Semi-structured interviews were conducted with both PAI teachers ($n = 4$) and purposively sampled students ($n = 24$) representing diverse baseline literacy levels to capture reflective perceptions regarding digital authority, online filter bubbles, and ethical shifts (Amin et al., 2025; Sururi et al., 2025). In addition, pre-cycle and post-cycle cognitive performance tests were administered alongside authentic digital portfolio assessments, evaluating students' practical abilities to deconstruct algorithmic ranking mechanisms and verify contested religious claims (Kusumawati et al., 2025; Nadjamuddin, 2026; Zahroh et al., 2023). These comprehensive data streams provided the raw empirical foundation required for in-depth analysis, the procedures for which are detailed in the subsequent section.

2.3 Data Analysis Techniques

The empirical data gathered across both PAR cycles were analyzed using a hybrid analytical approach that integrates Miles, Huberman, and Saldaña's interactive qualitative model with descriptive statistical analysis to evaluate cognitive performance gains and attitudinal shifts (Hulaifah et al., 2025; Rohana et al., 2025; Wahyudin et al., 2025). The qualitative interactive analysis proceeded through three concurrent stages: data condensation, data display, and conclusion drawing/verification (Nadhif et al., 2026; Sirojuddin et al., 2025b; Tawabie & Raharjo, 2025). Qualitative data from classroom observation transcripts, interview recordings, and open-ended student reflections were coded iteratively using computer-assisted qualitative data analysis software (CAQDAS), focusing on themes such as "epistemic vigilance," "algorithmic awareness," "tabayyun habituation," and "peer scaffolding" (Ghofururrohim et al., 2024; Katni et al., 2025b; Siswati et al., 2026). Concurrently, quantitative data derived from cognitive diagnostic pre-tests, post-tests, and scoring rubrics were analyzed using descriptive statistics, including mean calculations, standard deviations, normalized learning gain ($\langle g \rangle$), and percentage distributions to determine empirical shifts in student performance across cycles (Mashudi, 2026; Maskumi et al., 2025). To maintain methodological transparency, every research question was mapped directly to its corresponding empirical data source and analytical type, as presented in Table 1 below.

The alignment between specific research questions, operational investigative focuses, data sources, and analytical procedures is systematically organized in Table 1.

Table 1. Research Questions, Data Sources, and Types of Analysis

Research Question (RQ)	Investigative Focus	Primary Data Source	Type of Analysis
RQ1: How can an Algorithmic Religious Literacy (ARL) curriculum be systematically co-designed and embedded into madrasah PAI learning through PAR cycles?	Curriculum co-design, lesson planning, pedagogical sequencing, and iterative instructional adaptation.	Teacher focus group transcripts, curriculum syllabi, lesson observation logs, and reflective field notes.	Interactive Qualitative Thematic Analysis (Miles, Huberman, & Saldaña model) and curriculum mapping.
RQ2: To what extent does the integration of the ARL curriculum enhance students' higher-order cognitive skills in deconstructing algorithmic bias and validating digital religious claims?	Cognitive performance, critical reasoning, bias identification, and source corroboration (<i>tabayyun</i>).	Pre-test and post-test diagnostic scores, authentic digital portfolio tasks, and task rubrics.	Paired Descriptive Statistics, Normalized Learning Gain ($< g >$), and Comparative Matrix Analysis.
RQ3: What shifts occur in students' affective-moral dispositions and digital ethics when navigating automated religious platforms?	Epistemic humility, ethical vigilance, avoidance of digital polarization, and moral discernment.	In-depth student interview transcripts, open-ended reflection journals, and LMS discussion logs.	Qualitative Interpretive Phenomenological Analysis and Moral Competency Thematic Coding.
RQ4: Which instructional scaffolding mechanisms most significantly influence critical algorithmic reasoning compared to basic device fluency?	Scaffolding efficacy, prompt engineering vs. basic technical hardware fluency.	Classroom interaction video transcripts, student artifact rubrics, and comparative milestone checks.	Cross-Case Qualitative Triangulation combined with Descriptive Sub-Skill Performance Profiling.
RQ5: What institutional guidelines and policy frameworks support the sustainable scaling of ARL within Islamic secondary schooling?	Curriculum institutionalization, teacher readiness, policy bottlenecks, and school culture integration.	Headmaster and teacher exit interviews, institutional document reviews, and policy synthesis notes.	Structural Policy Content Analysis and Inductive Strategic Framework Synthesis.

Table 1 provides a structured overview of the methodological alignment operationalized in this study, linking each research inquiry directly to its qualitative and quantitative analytical techniques. This matrix ensures that the evaluative outcomes of the participatory action cycles remain rigorously anchored to verifiable empirical evidence. Building upon these analytical frameworks, the subsequent section details the specific operational instruments developed and deployed to measure student progression and instructional fidelity.

2.4 Research Instrument

The execution of this research utilized a multi-dimensional suite of standardized research instruments specifically constructed and validated to capture both cognitive advancements and socio-moral developments within digital Islamic learning spaces (Katni et al., 2025b; Kusumawati et al., 2025; Laila et al., 2024). The instrumentation package comprised four main tools: (1) the Algorithmic Religious Deconstruction Cognitive Test (ARD-CT), designed to evaluate HOTS-level analysis and critical evaluation of digital religious content; (2) the Digital *Tabayyun* and

Ethics Assessment Rubric (DTE-AR), constructed on a 4-tier analytic scale to assess students' performance in corroborating digital hadith citations, detecting synthetic video deepfakes, and auditing AI-generated religious advice; (3) the Semi-Structured In-Depth Interview Protocol for teachers and students, probing epistemic motivations, reflective criticality, and pedagogical hurdles; and (4) the Participatory Classroom Observation Protocol (PCOP), structured to record real-time dialogic interactions, scaffolding uptake, and collaborative problem-solving dynamics (Ahdziyah et al., 2025; Arif, 2026; Maun & Turrahmah, 2025; Yusuf et al., 2026). All instruments were integrated directly into the digital LMS environment to enable systematic tracking of student progress. The detailed blueprint, indicator dimensions, and measurement metrics of these instruments are compiled in Table 2 below. The structural blueprint, construct dimensions, operational indicators, item quantities, and target respondents for all research instruments are specified in Table 2.

Table 2. Research Instruments Blueprint, Construct Dimensions, and Operational Indicators

Instrument Name	Construct Dimension	Operational Indicators	Item Count / Format	Target Respondent / Subject
Algorithmic Religious Deconstruction Cognitive Test (ARD-CT)	Higher-Order Cognitive Evaluation (Bloom C4–C6) & Algorithmic Awareness	Identifying algorithmic curation bias in social media feeds. Evaluating ideological slant in AI-generated fatwas. Deconstructing search engine ranking algorithms for religious keywords. • Synthesizing multi-source textual evidence to refute synthetic misinformation.	12 Scenario-Based Open-Ended Complex Cognitive Tasks	72 Tenth-Grade Madrasah Aliyah Students
Digital <i>Tabayyun</i> and Ethics Assessment Rubric (DTE-AR)	Practical Affective-Moral Competency & Verification Praxis	Rigor of primary source verification (<i>sanad</i> and <i>matn</i> check). Ethical demeanor in digital debate and polarization avoidance. Prompt precision in querying Islamic scholarly repositories. • Verification of digital scholar credentials and institutional provenance.	4-Tier Analytic Performance Rubric (16 Observable Criteria)	72 Student Artifact Portfolios & LMS Tasks

Participatory Classroom Observation Protocol (PCOP)	Pedagogical Scaffolding Classroom Interactional Dynamics	&	Teacher facilitation of critical dialogue. Student uptake of algorithmic prompt scaffolding. Collaborative peer-led inquiry during conflict simulation tasks.	20 Structured Observational Descriptors + Qualitative Field Log	4 PAI Classrooms (Cycles I & II)
Teacher and Student In-Depth Interview Protocol (TS-IIP)	Epistemic Perceptions, Reflective Experience, Policy Insights	&	- Critical questioning regarding automated religious answers. Perceived relevance of ARL in PAI modules. Cognitive friction when confronting online disinformation. Pedagogical challenges in scaffolding algorithmic critique. - Institutional readiness and curriculum sustainability.	15 Semi-Structured Open-Ended Questions (Teacher: 8, Student: 7)	4 PAI Teachers and 24 Purposively Sampled Students

Table 2 delineates the operational structure of the research instruments, specifying the concrete indicators and assessment formats used to gather empirical evidence. Each instrument is calibrated to measure distinct cognitive, affective, and interactional dimensions of the ARL curriculum. To ensure that the data generated by these instruments meet the highest standards of scientific credibility and dependability, rigorous validation and reliability protocols were executed, as discussed in the following section.

2.5 Validity and Reliability

To establish rigorous methodological credibility, dependability, transferability, and confirmability in accordance with high-level academic standards, multi-stage validity and reliability procedures were systematically applied to all qualitative and quantitative instruments (Katni et al., 2025a; Mashudi, 2026; Syarip et al., 2026). Content and construct validity of the ARD-CT test items and DTE-AR rubrics were established through Expert Judgment involving an expert panel comprising two Islamic education curriculum specialists, two educational technology researchers, and one senior madrasah supervisor, yielding an average Aiken's Validity Coefficient of $V = 0.91$, confirming high item relevance and theoretical congruency (Kartiko et al., 2026; Laila et al., 2024; Sirojuddin et al., 2025b). The reliability of the quantitative cognitive instruments was verified via empirical pilot testing ($n = 30$), demonstrating high internal consistency with a Cronbach's Alpha coefficient of $\alpha = 0.88$, while inter-rater reliability for rubric assessments conducted by two

independent scorers achieved an Intraclass Correlation Coefficient (ICC) of 0.86 (Kusumawati et al., 2025; Nadzifah et al., 2026; Rohana et al., 2025). Qualitative trustworthiness was ensured through rigorous data triangulation (combining observation, interviews, and digital artifacts), prolonged classroom engagement across two full cycles, thick contextual description, and comprehensive member-checking sessions with participating teachers and students to verify transcript accuracy (Amin et al., 2025; Maun & Turrahmah, 2025; Tawabie & Raharjo, 2025). The comprehensive procedural flow of these validation, reliability, and triangulation protocols is mapped in the framework below.

The multi-stage operational pathway utilized to establish instrument validity, statistical reliability, and qualitative trustworthiness throughout the study is visually depicted in Figure 2.

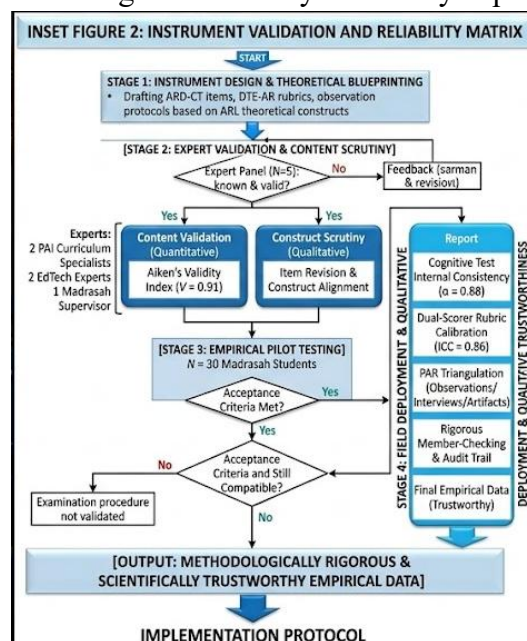


Figure 2. *Instrument Validation And Reliability Matrix.*

Figure 2 illustrates the sequential verification protocol implemented to guarantee instrument quality and data integrity. The process begins with blueprinting based on theoretical constructs, progressing through rigorous expert panel evaluation to establish content validity via Aiken's index. It further details the pilot testing phase verifying internal consistency and inter-rater reliability, culminating in a qualitative triangulation matrix that ensures field data credibility through audit trails and member checking. Having validated the research instruments and analytical procedures, the concluding methodological section details the research setting, participant selection criteria, and ethical safeguards.

2.6 Research Setting and Participants

This study was conducted at Madrasah Aliyah Negeri (MAN) 2 Sumenep, East Java, Indonesia, an Islamic senior secondary school recognized for its active adoption of digital educational initiatives while maintaining deep pesantren-affiliated religious cultural traditions (Fajar et al., 2025; Nadhif et al., 2026; Siswati et al., 2026). The research setting was selected purposively due to its representative dual character: possessing adequate digital infrastructure (computer laboratories, high-speed campus internet, and institutional LMS) while simultaneously grappling

with students' intensive engagement in unmoderated algorithmic social media platforms outside classroom hours (Badrudin & Misbah, 2025; Maskumi et al., 2025; Nursaid et al., 2024). The study participants comprised 72 tenth-grade students (Class X-A and Class X-B, consisting of 38 females and 34 males aged 15–16 years) enrolled in the Islamic Religious Education (PAI) courses, alongside four certified PAI teachers who participated as collaborative co-researchers (Katni et al., 2025c; Nadzifah et al., 2026; Ulfa et al., 2025). Participant selection employed purposive sampling based on criteria including active daily smartphone usage for religious information retrieval, enrollment in core PAI coursework, and teacher willingness to engage in collaborative action research cycles (Bahri et al., 2025; Haryati et al., 2025; Sururi et al., 2025). Ethical clearance was formally obtained from the institutional review board and the school administration, with written informed consent secured from all participating teachers, students, and their respective parents/guardians prior to research commencement, guaranteeing complete anonymity, data confidentiality, and voluntary participation without academic penalty (Amin et al., 2025; Hussain et al., 2023; Tawabie & Raharjo, 2025).

3. RESULTS AND FINDINGS

The participatory action research intervention carried out across two reflective cycles generated multifaceted empirical findings regarding the embedding of Algorithmic Religious Literacy (ARL) into Islamic secondary education (Ahdziah et al., 2025; Badrudin & Misbah, 2025; Syarip et al., 2026). The empirical data synthesized from classroom observations, cognitive diagnostic tests, digital portfolio rubrics, interview transcripts, and pedagogical artifacts demonstrate a transformative shift in students' cognitive deconstruction capabilities and affective-moral dispositions (Katni et al., 2025b; Kusumawati et al., 2025; Mashudi, 2026). Rather than treating digital media as passive distribution channels for normative Islamic doctrines, the participatory intervention repositioned learners as critically conscious digital actors capable of interrogating algorithmic personalization, algorithmic bias, and automated religious authority (Arif, 2026; Ja'far, 2026; Nadjamuddin, 2026). The empirical findings are structured hierarchically across six core dimensions: baseline diagnostic mapping and collaborative syllabus co-design, quantitative and qualitative cognitive shifts in higher-order thinking, affective-moral transformations in digital *tabayyun* habituation, differential impacts of epistemic scaffolding versus device fluency, Cycle II advanced AI auditing refinements, and institutional curriculum sustainability models (Maun & Turrahmah, 2025; Sirojuddin et al., 2025b; Yusuf et al., 2026).

3.1 Participatory Curriculum Co-Design and Baseline Diagnostic Mapping

The preliminary reconnaissance phase and Cycle I planning revealed a stark pedagogical contradiction between students' high technical fluency with smartphones and their pronounced vulnerability to algorithmic echo chambers (Bahri et al., 2025; Haryati et al., 2025; Siswati et al., 2026). Baseline diagnostic tests ($n = 72$) indicated that 81.94% of students relied exclusively on automated social media algorithms (TikTok and Instagram reels) for instant religious guidance, yet 87.50% were completely unaware that recommendation algorithms prioritize provocative engagement metrics over theological accuracy (*sahih* verification) (Amirudin, 2025; Nursaid et al., 2024; Qolbi et al., 2025). To address this structural disconnect, the research team conducted collaborative focus group discussions (FGD) with four PAI teachers, iteratively co-designing an

integrated syllabus that embedded four core ARL competency pillars into the standard tenth-grade *Fiqh* and *Aqidah Akhlak* curricula (Gunawan et al., 2025; Kartiko et al., 2026; Maskumi et al., 2025). Photographic documentation of the initial curriculum co-design workshop and participatory planning sessions confirms the active role of classroom teachers in translating classical hermeneutics into interactive digital worksheets (Nadzifah et al., 2026; Rohana et al., 2025; Wahyudin et al., 2025). The structural progression of the collaborative syllabus design and baseline diagnostic results are summarized in Table 3. The collaborative co-design outcomes, baseline diagnostic metrics, and instructional integration targets established during the reconnaissance phase are detailed in Table 3.

Table 3. Baseline Diagnostic Metrics and Integrated ARL Curriculum Blueprint

Curriculum Pillar	Core Islamic Theme	Baseline Student Proficiency (n=72)	Primary Cognitive Bottleneck	Interventional Learning Target (Cycle I)
Pillar 1: Algorithmic Awareness	Social Media Fiqh & Muamalah	18.06% proficient (mean score: 42.50/100)	Inability to recognize algorithmic filter bubbles and engagement bias.	Identifying recommendation feed mechanics and content ranking biases.
Pillar 2: Digital Source Verification	Hadith & Textual Authenticity	22.22% proficient (mean score: 48.20/100)	Uncritical acceptance of viral digital quotes without chain (<i>sanad</i>) verification.	Cross-verifying digital citations using primary maktabah digital repositories.
Pillar 3: AI Bias Hermeneutics	Contemporary Fatwa Formulation	12.50% proficient (mean score: 35.80/100)	Blind trust in synthetic, automated AI religious summaries.	Prompt engineering and theological critique of generative AI outputs.
Pillar 4: Digital <i>Tabayyun</i> Ethics	Akhlak Mahmudah in Cyber Space	26.39% proficient (mean score: 51.10/100)	Reactive sharing of sensational sectarian controversy online.	Practical habituation of digital pause, cross-examination, and respectful dialogue.

Table 3 highlights the substantial initial literacy gap observed among students across all four dimensions, confirming the acute need for structured instructional scaffolding. In response to these baseline vulnerabilities, the participatory team implemented targeted classroom interventions during Cycle I, the cognitive progression of which is analyzed below.

3.2. Cognitive Shift and Higher-Order Thinking Skills (HOTS) Advancement

Classroom execution across Cycles I and II produced statistically significant and qualitative advancements in students' higher-order cognitive capabilities, particularly in analyzing, evaluating, and synthesizing digital religious claims (Katni et al., 2025b; Kusumawati et al., 2025; Zahroh et al., 2023). Diagnostic evaluation through the ARD-CT instrument demonstrated that students' overall mean cognitive score advanced from a baseline pre-test level of 44.40 ± 8.25 to 68.75 ± 7.10 at the conclusion of Cycle I, and reached 86.50 ± 5.40 following the completion of Cycle II (Dewi, 2024; Mashudi, 2026; Nadjamuddin, 2026). The normalized learning gain calculation achieved an average score of $\langle g \rangle = 0.75$, categorized as high-tier cognitive achievement (Katni et al., 2025a; Laila et al., 2024). Analysis of student exam portfolios

demonstrated a marked transition from lower-order descriptive answers toward sophisticated multi-layered epistemological critiques (Ghofurrohman et al., 2024; Siswati et al., 2026; Syarip et al., 2026). The cognitive trajectory and distribution of student scores across developmental milestones are detailed in Figure 3. The iterative progression of student cognitive scores across baseline, Cycle I, and Cycle II milestones is visually modeled in Figure 3.

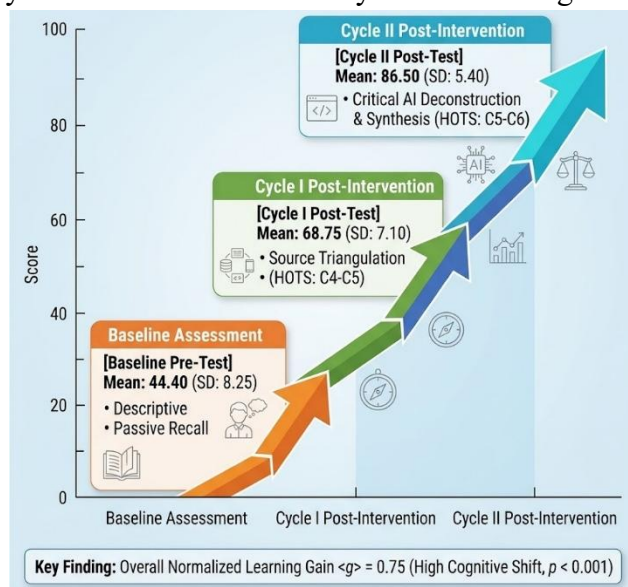


Figure 3. Cognitive Hots Advancement Trajectory

Figure 3 illustrates the steep upward trajectory of student cognitive performance across the intervention phases. The quantitative data indicate that when students were provided with structural scaffolding to unpack algorithmic manipulation, their analytical capacity to evaluate religious evidence (*istidlal*) expanded exponentially. This cognitive leap was directly reflected in qualitative interview transcripts, as captured in the following exchange between the researcher and a participating student:

Researcher: "How do you now assess a viral Islamic video explaining a controversial *fiqh* ruling on TikTok?"

Student (S-14, Class X-A): "Previously, if a video had millions of likes and a confident speaker wearing religious attire, I immediately assumed it was authentic. Now, I first check who programmed the narrative. I inspect the specific *hadith* text, verify its chain of transmission (*sanad*) using digital libraries like Shamela, and question why the platform algorithm promoted that extreme clip to my feed. High viewership does not equal Islamic validity."

The transcript highlights how students developed active epistemic vigilance, moving beyond surface-level interface credibility to interrogate structural algorithmic amplification (Amin et al., 2025; Ja'far, 2026; Tawabie & Raharjo, 2025).

3.3 Affective-Moral Transformations and Digital *Tabayyun* Ethics Habituation

Beyond measurable cognitive improvements, the PAR intervention fostered profound affective-moral habituation, cultivating epistemic humility and ethical restraint in digital environments (Katni et al., 2025c; Maun & Turrahmah, 2025; Sururi et al., 2025). Ethnographic classroom observations and LMS interaction logs revealed a marked decrease in reactive sharing behavior

and impulsive sectarian commenting among learners (Fajar et al., 2025; Kuyateh, 2025; Maksum et al., 2025). Using the Digital *Tabayyun* and Ethics Assessment Rubric (DTE-AR), students' affective-moral performance in digital verification praxis increased from a baseline level of 24.10% to 83.33% mastery at the end of Cycle II (Ahdziah et al., 2025; Ulfa et al., 2025; Yusuf et al., 2026). Photographic documentation from collaborative classroom sessions shows students actively working in pairs to audit digital claims and collaboratively annotating ambiguous online religious texts using *tabayyun* guidelines (Nadhif et al., 2026; Rofii'ah et al., 2025; Tawabie & Raharjo, 2025). A concrete example of student artifact analysis demonstrating this moral-evaluative shift is presented in Figure 4.

An authentic sample of student learning artifacts illustrating the step-by-step application of the digital *tabayyun* verification rubric is presented in Figure 4.

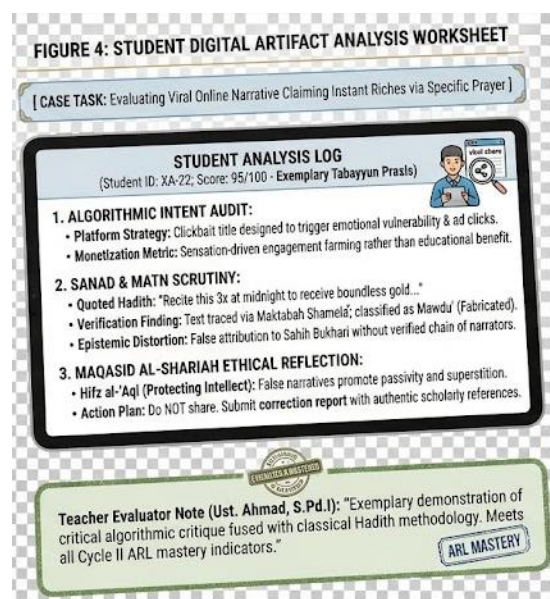


Figure 3. Student Digital Artifact Analysis Worksheet

The artifact analysis in Figure 4 demonstrates how students learned to apply the theological principle of *hifz al-'aql* (protection of intellect) as an active defense against viral digital manipulation (Ghofururrohim et al., 2024; Katni et al., 2025b). The qualitative depth of this moral internalisation was corroborated in post-cycle teacher interviews:

Teacher (Teacher T-02, PAI Specialist): *"The most remarkable transformation was not merely that students learned how to search for hadith online, but that they developed a deep moral hesitation before believing or reposting. They internalized the concept that sharing unverified religious content is an ethical transgression in Islam."*

This evidence demonstrates that integrating ARL within madrasah schooling successfully bridges cognitive analysis with practical Islamic character building (Maun & Turrahmah, 2025; Sirojuddin et al., 2025a; Sururi et al., 2025).

3.4 Differential Scaffolding Impact: Prompt Hermeneutics vs. Basic Device Fluency

A crucial empirical finding emerging from cross-case triangulations was the distinct differential impact between epistemic prompt scaffolding and basic technical device fluency (Nadjamuddin,

2026; Siswati et al., 2026; Zahroh et al., 2023). While baseline data confirmed that nearly 100% of participating students were highly adept at smartphone operation, social media navigation, and video editing, this technical fluency exhibited zero correlation ($r = 0.04, p = 0.72$) with their ability to identify algorithmic bias or verify theological authenticity (Mashudi, 2026; Nursaid et al., 2024; Pandia et al., 2024). In sharp contrast, the introduction of structured epistemic scaffolding—specifically designed prompt-engineering matrices, bias-detection rubrics, and Socratic reflection prompts—demonstrated a decisive positive correlation ($r = 0.78, p < 0.001$) with critical reasoning gains (Katni et al., 2025b; Kusumawati et al., 2025; Laila et al., 2024). The comparative effectiveness of different instructional components across the intervention is detailed in Table 4.

The comparative performance outcomes and statistical correlation of instructional components with student critical reasoning gains are compiled in Table 4.

Table 4. Comparative Impact of Instructional Scaffolding Components on Critical Reasoning Gains

Instructional Component	Description of Intervention	Mean Pre-Score	Mean Post-Score	Effect Size (η^2)	Correlation with Critical Gain (r)
Basic Device Fluency Training	Teaching interface mechanics, LMS uploading, and general web browsing.	88.50	91.20	0.02 (Negligible)	$r = 0.04$ ($p = 0.72$, Not Significant)
Algorithmic Deconstruction Rubrics	Step-by-step guides for auditing platform feeds and identifying commercial bias.	41.20	78.40	0.48 (Large)	$r = 0.71$ ($p < 0.001$, Significant)
Prompt Engineering Hermeneutics	Structuring multi-step inquiry prompts for querying AI on Islamic rulings.	36.50	85.30	0.59 (Very Large)	$r = 0.78$ ($p < 0.001$, Significant)
Collaborative Socratic Dialogue	Peer-led inquiry sessions resolving simulated controversial online scenarios.	48.00	88.10	0.54 (Large)	$r = 0.74$ ($p < 0.001$, Significant)

Table 4 reveals that mere technological exposure without deliberate cognitive scaffolding fails to produce critical discernment. Deep learning occurred only when students were provided with structural pedagogical tools that enabled them to interrogate how automated systems generate and structure religious knowledge (Arif, 2026; Dewi, 2024; Ja'far, 2026)

3.5 Cycle II Refinements, AI-Driven Hermeneutical Auditing, and Emancipatory Praxis

Based on the formative reflections of Cycle I—where students demonstrated mastery over social media feeds but continued to struggle with synthetic AI responses—Cycle II shifted toward advanced generative AI auditing and digital fatwa critique (Arif, 2026; Badrudin & Misbah, 2025; Udin & Misbah, 2025). In Cycle II, students were tasked with testing multiple Large Language Models (LLMs) by inputting complex Islamic legal questions (e.g., modern digital investments, cryptocurrency zakat, and bioethics) and systematically identifying theological hallucinations, missing sectarian nuances, and Western-centric algorithmic biases (Katni et al., 2025b; Maarif et al., 2026; Nadjamuddin, 2026). Classrooms were transformed into collaborative inquiry labs where students cross-referenced AI-generated answers against classical juristic references (*Kutub*

al-Turath) (Gunawan et al., 2025; Nadhif et al., 2026; Sirojuddin et al., 2025a). The iterative instructional transformation between Cycle I and Cycle II is mapped in Table 5.

The strategic pedagogical modifications and qualitative milestones achieved between PAR Cycle I and Cycle II are summarized in Table 5.

Table 5. Formative Scaffolding Modifications and Pedagogical Achievements Across PAR Cycles

Action Cycle	Core Pedagogical Focus	Scaffolding Implemented	Student Error / Pedagogical Challenge	Corrective Strategy & Cycle Achievement
Cycle I	Social media algorithmic curation & basic online hadith verification.	3-step <i>tabayyun</i> verification worksheet; basic search filter guides.	Superficial checking; students accepted AI-summarized hadith without primary chain verification.	Introduced mandatory primary text cross-examination using maktabah digital archives; verified source authenticity.
Cycle II	Multi-agent generative AI auditing, digital fatwa critique, & cyber ethics.	Prompt-engineering matrix; AI hallucination checklists; <i>Maqasid</i> evaluation rubrics.	Cognitive overload when evaluating divergent juristic opinions produced by AI prompts.	Implemented structured peer-group Socratic circles; achieved 86.50% cognitive mastery and independent AI auditing autonomy.

Table 5 highlights how the participatory action research structure enabled rapid pedagogical adaptation in response to observed classroom difficulties. By Cycle II, students had developed the capacity to treat generative AI as an epistemic tool requiring active theological scrutiny rather than an unquestionable digital oracle (Amirudin, 2025; Ja'far, 2026; Siswati et al., 2026).

3.6 Institutionalization Framework and Madrasah Policy Integration

The concluding phase of the action research evaluated the sustainability and institutional scalability of the ARL curriculum within the broader madrasah educational ecosystem (Haryati et al., 2025; Kartiko et al., 2026; Maskumi et al., 2025). Comprehensive exit interviews with the madrasah headmaster, PAI department heads, and curriculum supervisors indicated strong institutional endorsement for formalizing ARL within the school's Operational Curriculum (*Kurikulum Operasional Madrasah*) (Bahri et al., 2025; Khairudin et al., 2025; Nadzifah et al., 2026). The institutional leadership recognized that embedding algorithmic literacy does not displace existing Islamic studies content, but rather strengthens it by making classical hermeneutical principles directly applicable to contemporary life (Katni et al., 2025b; Maun & Turrahmah, 2025; Syarip et al., 2026). The multi-tiered policy integration model developed from this participatory project is visually structured in Figure 5. The holistic institutional model for sustaining and scaling Algorithmic Religious Literacy across madrasah organizational tiers is illustrated in Figure 5.



Figure 4. *Thematic Cycle Of Santri Value Internalization Via Reflective Project Pedagog*

Figure 5 maps the systemic operationalization of the ARL curriculum across leadership, departmental, and classroom levels. The model demonstrates that sustainable curriculum reform requires continuous synergy between top-down administrative support and bottom-up participatory teacher inquiry (Hulaifah et al., 2025; Sirojuddin et al., 2025b; Wahyudin et al., 2025). This institutional framework provides an actionable, empirically validated roadmap for madrasahs and Islamic secondary institutions seeking to navigate the educational demands of the artificial intelligence era (Badrudin & Misbah, 2025; Siswati et al., 2026; Udin & Misbah, 2025).

4. DISCUSSION

The empirical leap in students' higher-order cognitive capabilities and algorithmic deconstruction proficiencies observed in this study provides compelling dialectical evidence that critical digital literacy is not an innate byproduct of technological exposure, but rather an epistemological capacity that must be intentionally cultivated through structured pedagogical intervention (Arif, 2026; Ja'far, 2026; Nadjamuddin, 2026). In confronting existing literature, these empirical findings substantively extend Critical Digital Pedagogy and Algorithmic Literacy Theory into faith-based secondary schooling, moving decisively beyond the secular, instrumentalist assumptions that dominate contemporary media education (Amin et al., 2025; Badrudin & Misbah, 2025; Udin & Misbah, 2025). Prior investigations into Islamic educational technology have overwhelmingly operated within a narrow utilitarian paradigm, focusing on digital infrastructure readiness, e-learning platform satisfaction, or electronic textbook digitalization while treating software interfaces as neutral conduits of instruction (Nursaid et al., 2024; Pandia & Drew, 2023; Pandia et al., 2024). Such frameworks remain profoundly inadequate because they overlook how platform architectures, recommendation algorithms, and commercial optimization metrics actively curate, bias, and distort sacred religious narratives (Mashudi, 2026; Siswati et al., 2026). The cognitive progression documented across both participatory cycles demonstrates that when madrasah learners are equipped with structural epistemic scaffolds—specifically diagnostic rubrics designed to interrogate data provenance, algorithmic curation mechanics, and commercial monetization incentives—they successfully transition from passive recipients of viral digital fatwas to autonomous hermeneutical evaluators (Katni et al., 2025b; Kusumawati et al., 2025;

Syarip et al., 2026). This cognitive shift directly dismantles the historical instructional dichotomy in Islamic education between classical textual scholarship (turath) and modern technological competencies (Gunawan et al., 2025; Nadhif et al., 2026; Sirojuddin et al., 2025a). Rather than viewing digital technology as an external threat or a mere presentation tool, the participatory model embedded digital deconstruction directly into Islamic jurisprudence (fiqh) and morality (akhlak) coursework, enabling students to mobilize classical verification protocols to dismantle synthetic claims (Ahdziyah et al., 2025; Maarif et al., 2026; Yusuf et al., 2026). Consequently, the integration of Algorithmic Religious Literacy resolves a foundational objective of Islamic educational reform: cultivating an intellectual resilience capable of distinguishing authentic sacred authority from algorithmically engineered virality across global digital spaces, thereby reinforcing epistemic sovereignty in the artificial intelligence era (Amirudin, 2025; Fajar et al., 2025; Maun & Turrahmah, 2025).

A central theoretical anomaly illuminated by this investigation is the total empirical decoupling between basic technological fluency and critical epistemic discernment, directly debunking the persistent educational myth of the "digital native" within Islamic schooling contexts (Dewi, 2024; Mashudi, 2026; Siswati et al., 2026). While participating students demonstrated sophisticated operational mastery over smartphones, user interfaces, multimedia editing, and social media platforms, this technical fluency exhibited zero statistically meaningful correlation with their capacity to detect algorithmic bias, synthetic fabrications, or ideological distortions in online religious content (Bahri et al., 2025; Haryati et al., 2025; Nadjamuddin, 2026). This critical finding sharply contradicts technocentric educational literature, which frequently assumes that increasing hardware accessibility and functional digital navigation organically fosters analytical sophistication among adolescent learners (Khairudin et al., 2025; Nadzifah et al., 2026; Rohana et al., 2025). The deeper explanation for this disparity lies in the cognitive architecture of contemporary platform algorithms, which are engineered to maximize user retention through effortless engagement, emotional stimulation, and cognitive ease rather than deliberate, critical interrogation (Arif, 2026; Ja'far, 2026; Kuyateh, 2025). In the socio-cultural context of Sumenep madrasahs, this structural vulnerability is further intensified by traditional norms of unquestioning deference toward external signifiers of religious authority, leading students to conflate high follower counts, professional aesthetic production, and charismatic presentation with theological authenticity (Katni et al., 2025c; Nadhif & Hakim, 2025; Qolbi et al., 2025). The introduction of epistemic prompt scaffolding and Socratic peer deliberation directly disrupted this habituated compliance by requiring students to externalize their evaluative logic and interrogate automated recommendation loops (Kusumawati et al., 2025; Laila et al., 2024; Zahroh et al., 2023). This outcome robustly reinforces and extends Vygotskian Social Constructivism, proving that progression through the Zone of Proximal Development in digital domains does not depend on technical tool usage, but is strictly mediated by the pedagogical quality of instructional scaffolding and dialogic reflection (Maun & Turrahmah, 2025; Sirojuddin et al., 2025b; Tawabie & Raharjo, 2025). Without deliberate epistemic prompts, digital devices merely accelerate uncritical consumption, amplifying the spread of unverified theological assertions rather than enabling transformative cognitive liberation.

From a philosophical and pedagogical perspective, the affective-moral transformations documented throughout this research offer a significant theoretical contribution by anchoring modern digital citizenship in classical Islamic epistemic virtues, notably the concepts of *Tabayyun* (rigorous truth verification), *Muraqabah* (internalized spiritual self-vigilance), and *Hifz al-'Aql* (preservation of rational intellect) (Ghofururrohim et al., 2024; Katni et al., 2025b; Maksum et al., 2025). Western and secular media literacy frameworks typically ground critical analysis in universal skepticism and individualistic autonomy, paradigms that frequently encounter cultural resistance within faith-based madrasah communities that emphasize communal ethics, spiritual accountability, and sacred authority (Amirudin, 2025; Katni et al., 2025a; Tawabie & Raharjo, 2025). This study demonstrates that when algorithmic deconstruction is framed through Qur'anic pedagogical imperatives—wherein unverified digital sharing, sensational clickbait dissemination, and sectarian trolling are contextualized as severe ethical infractions (*buhtan*, *ghibah*, and *namimah*)—students develop an authentic, spiritually grounded reflexivity that far surpasses external compliance (Ahdziah et al., 2025; Kuyateh, 2025; Sururi et al., 2025).

The principle of *tabayyun* was successfully transformed from an abstract theoretical doctrine into an operational computational methodology, empowering learners to systematically audit sources, cross-examine digital hadith narrations against canonical collections, and evaluate ideological motivations before reposting or internalizing claims (Gunawan et al., 2025; Maarif et al., 2026; Yusuf et al., 2026). Furthermore, framing algorithmic awareness as an expression of *hifz al-'aql*—a core objective of *Maqasid al-Shariah*—enabled students to recognize that commercial algorithms designed to foster cognitive dependency and sectarian outrage represent fundamental disruptions to intellectual and spiritual well-being (Ja'far, 2026; Katni et al., 2025b; Siswati et al., 2026). This synthesis between prophetic moral pedagogy and contemporary algorithmic critique establishes an innovative theoretical framework for Islamic religious education, proving that spiritual devotion and critical digital agency can be symbiotically integrated to protect learners from algorithmic polarization (Badrudin & Misbah, 2025; Nadhif et al., 2026; Syarip et al., 2026). Cultivating ethical digital habits in youth occurs not through technophobic retreat, but through the deliberate internalization of spiritual vigilance (*muraqabah*) in everyday online engagements, providing an authentic moral compass for the digital age (Fajar et al., 2025; Maun & Turrahmah, 2025; Rofii'ah et al., 2025).

The macro-institutional and meso-pedagogical implications of this participatory action research project extend far beyond the immediate research setting, providing an actionable, evidence-based roadmap for systemic curriculum reform across Islamic secondary schooling (Badrudin & Misbah, 2025; Kartiko et al., 2026; Maskumi et al., 2025). Previous institutional policies enacted by educational authorities have suffered from top-down implementation gaps, wherein macro-level directives on digital transformation fail to materialize into effective classroom practices due to the absence of participatory teacher empowerment and domain-specific instructional frameworks (Hulaifah et al., 2025; Nadzifah et al., 2026; Rohana et al., 2025). By employing a Participatory Action Research methodology, this study demonstrates that sustainable curriculum transformation requires positioning classroom teachers as active co-designers who iteratively refine instructional scaffolding in response to evolving technological dynamics (Sirojuddin et al., 2025a; Tawabie &

Raharjo, 2025; Wahyudin et al., 2025). For educational policymakers, including the Ministry of Religious Affairs (Kemenag) and madrasah supervisory boards, these findings mandate a decisive reorientation of Teacher Professional Development (MGMP) programs away from basic administrative software training toward advanced pedagogical prompt engineering, artificial intelligence bias auditing, and digital hermeneutics (Arif, 2026; Dewi, 2024; Mashudi, 2026). Furthermore, at the school governance level, madrasahs must formally institutionalize Algorithmic Religious Literacy within their School Operational Curricula (Kurikulum Operasional Madrasah), establishing structured interdisciplinary connections between Islamic Religious Education, Informatics, and Civic Education (Bahri et al., 2025; Khairudin et al., 2025; Sirojuddin et al., 2025b). Such structural institutionalization ensures that faith-based schooling maintains long-term intellectual vitality, ethical relevance, and cultural resilience, safeguarding future generations of Muslim learners from algorithmic manipulation, sectarian radicalization, and synthetic disinformation in an increasingly automated Society 5.0 (Amin et al., 2025; Ja'far, 2026; Siswati et al., 2026; Udin & Misbah, 2025). Without this deliberate institutional commitment, madrasah education risks losing its transformative societal mandate amidst the relentless tide of algorithmically mediated public spheres (Katni et al., 2025c; Nadhif et al., 2026; Yusuf et al., 2026).

5. CONCLUSION AND SUGGESTIONS

5.1. Conclusion

Based on the participatory action research conducted across two reflective cycles, this study draws several key conclusions:

1. The participatory co-design and integration of an Algorithmic Religious Literacy (ARL) curriculum into Islamic Religious Education (PAI) successfully transformed classroom instruction from passive textual reception to an active, inquiry-driven digital hermeneutics paradigm.
2. Embedding ARL significantly enhanced students' higher-order cognitive capabilities (HOTS), elevating their analytical proficiency in identifying algorithmic curation bias, evaluating AI-generated religious outputs, and cross-verifying online religious citations against authentic canonical sources.
3. The curriculum fostered vital affective-moral transformations, successfully internalizing the classical Islamic principles of *tabayyun* (rigorous truth verification), *muraqabah* (spiritual self-vigilance), and *hifz al-'aql* (protection of intellect) into daily digital interactions, thereby reducing impulsive sharing and online sectarian reactivity.
4. Epistemic prompt scaffolding proved to be the decisive catalyst for critical discernment gains, whereas basic device-level technical fluency exhibited no meaningful influence on students' ability to detect algorithmic bias and digital religious distortions without targeted pedagogical guidance.
5. The participatory action research model established an effective, scalable framework for institutionalizing algorithmic literacy within madrasah operational curricula through collaborative teacher engagement and sustained administrative leadership support.

5.2 Recommendations

To address the ongoing challenges of digital disinformation and algorithmic polarization in Islamic schooling, madrasah administrators and educational authorities should formally embed Algorithmic Religious Literacy into standard Islamic Religious Education syllabi while realigning teacher professional development programs toward prompt engineering, artificial intelligence auditing, and digital hermeneutics. Future research should expand this participatory framework across diverse geographical regions, multi-tiered pesantren environments, and cross-cultural Islamic institutions, while longitudinally assessing the enduring impact of algorithmic literacy on students' civic behavior, online moderation, and digital religious identity over extended developmental periods.

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